

**US-PAT-NO:** 6654506  
**DOCUMENT-IDENTIFIER:** US 6654506 B1  
**TITLE:** Method for automatically creating  
cropped and zoomed versions of  
photographic images  
**DATE-ISSUED:** November 25, 2003

**INVENTOR-INFORMATION:**

NAME	CITY	STATE	ZIP CODE	COUNTRY
Luo; Jiebo	Rochester	NY	N/A	N/A
Gray; Robert T.	Rochester	NY	N/A	N/A

**US-CL-CURRENT:** 382/282, 345/620, 358/453, 382/173

**CLAIMS:**

What is claimed is:

1. A method of cropping a digital image comprising: inputting a belief map of a photographic image, said belief map comprising a plurality of belief values, each belief value at each location in said belief map indicating an importance of a photographic subject at said location, wherein a photographic subject having a highest belief value comprises a main subject; selecting a crop window having a shape and a zoom factor, said shape and zoom factor determining a size of said crop window; positioning said crop window such that said crop window is centered at a center-of-mass of said main subject; moving said crop window such that said crop window is completely within said image; moving said

crop window such that a sum of belief values of said crop window is at a maximum; and cropping said image according to said crop window.

2. The method in claim 1, further comprising moving said crop window such that said crop window includes all of at least one main subject.

3. The method in claim 2, further comprising moving said crop window to include a buffer around said main subject.

4. The method in claim 1, further comprising clustering regions of said belief map to identify background subjects and secondary subjects.

5. The method in claim 4, wherein said clustering includes setting said background portions to a zero belief value.

6. The method in claim 1, further comprising repeating said moving processes with a rotated image and determining if said rotated image produces a higher sum of belief values.

7. The method in claim 6, further comprising repeating said positioning process and said moving processes with said rotated image and determining if said rotated image produces a higher sum of belief values.

8. The method in claim 1, further comprising repeating said processes with a second zoom factor and a second crop window and determining if said second zoom factor and said second crop window produces a higher sum of belief values.

9. A method of cropping an image comprising: inputting a belief map of a photographic image, said

belief map comprising a plurality of belief values, each belief value at each location in said belief map indicating an importance of a photographic subject at said location wherein a photographic subject having a highest belief value comprises a main subject; selecting a crop window; positioning said crop window such that said crop window is centered around said main subject; and cropping said image according to said crop window.

10. The method in claim 9, further comprising selecting a zoom factor in order to determine a size of said crop window.

11. The method in claim 10, wherein said zoom factor is selected according to a size of said main subject.

12. The method in claim 9, further comprising clustering regions of said belief map into belief categories.

13. The method in claim 12, wherein said clustering includes setting portions of said belief map having a lowest belief value to a zero belief value.

14. The method in claim 9, further comprising moving said crop window such that said crop window is completely within said image.

15. The method in claim 9, further comprising moving said crop window such that a sum of belief values of said crop window is at a maximum.

16. The method in claim 9, further comprising moving said crop window such that said crop window includes all of said main subject.

17. The method in claim 9, further comprising moving said crop window to include a buffer around said main subject.

18. The method in claim 9, further comprising repeating said moving processes with a rotated image and determining if said rotated image produces a higher sum of belief values.

19. The method in claim 9, further comprising repeating said positioning process and said moving processes with a rotated image and determining if said rotated image produces a higher sum of belief values.

20. The method in claim 9, further comprising repeating said processes with a second crop window and determining if said second crop window produces a higher sum of belief values.

21. A method of using a computer program operating on a computer to crop an image comprising: using said computer program to input a belief map of a photographic image, said belief map comprising a plurality of belief values, each belief value at each location in said belief map indicating an importance of a photographic subject at said location, wherein a photographic subject having a highest belief value comprises a main subject; using said computer program to select a crop window; using said computer program to position said crop window such that said crop window is centered around said main subject; and using said computer program to crop said image according to said crop window.

22. The method in claim 21, further comprising using said computer program to select a zoom factor.

23. The method in claim 21, further comprising

using said computer program to cluster regions of said belief map into belief categories.

24. The method in claim 23, wherein said using said computer program to cluster includes using said computer program to set portions of said belief map having a lowest belief value to a zero belief value.

25. The method in claim 21, further comprising using said computer program to move said crop window such that said crop window is included completely within said image.

26. The method in claim 21, further comprising using said computer program to move said crop window such that a sum of belief values is at a maximum.

27. The method in claim 21, further comprising using said computer program to move said crop window such that said crop window includes all of said main subject.

28. The method in claim 21, further comprising using said computer program to move said crop window to include a buffer around said main subject.

29. The method in claim 21, further comprising using said computer program to repeat said move processes with a rotated image and using said computer program to determine if said rotated image produces a higher sum of belief values.

30. The method in claim 21, further comprising using said computer program to repeat said position process and said move processes with a rotated image and using said computer program to determine if said rotated image produces a higher sum of belief values.

31. The method in claim 21, further comprising using said computer program to repeat said processes with a second crop window and using said computer program to determine if said second crop window produces a higher sum of belief values.

32. A system for cropping images comprising: an input receiving a belief map of a photographic image, said belief map comprising a plurality of belief values, each belief value at each location in said belief map indicating an importance of a photographic subject at said location, wherein a photographic subject having a highest belief value comprises a main subject; a selector choosing a crop window; a window mover positioning said crop window such that said crop window is centered around said main subject; and a cropper modifying said image according to said crop window.

33. The system in claim 32, further comprising a second selector selecting a zoom factor.

34. The system in claim 32, further comprising a comparator clustering regions of said belief map into belief categories.

35. The system in claim 34, wherein said comparator sets portions of said belief map having a lowest belief value to a zero belief value.

36. The system in claim 32, wherein said window mover moves said crop window such that said crop window is completely within said image.

37. The system in claim 32, wherein said window mover moves said crop window such that a sum of belief values is at a maximum.

38. The system in claim 32, wherein said window

mover moves said crop window such that said crop window includes all of said main subject.

39. The system in claim 32, wherein said window mover moves said crop window to include a buffer around said main subject.

40. The system in claim 32, wherein said window mover repeats said moving processes with a rotated image and determines if said rotated image produces a higher sum of belief values.

41. The system in claim 32, wherein said window mover repeats said positioning process and said moving processes with a rotated image and determines if said rotated image produces a higher sum of belief values.

42. The system in claim 32, wherein said selector, window mover and cropper repeat said processes with a second crop window and determine if said second crop window produces a higher sum of belief values.

~~43. A method of cropping a digital image having pixels to produce a cropped digital image,~~  
comprising: developing a belief map of a photographic image by using such pixels to determine a series of features and using such features to assign a probability of a location of a main subject of the digital image in the belief map; and cropping the digital image to include main subjects indicated by the belief map to produce the cropped digital image.

44. A method of cropping a digital image having pixels to produce a cropped digital image, comprising: a) developing a belief map of a photographic image by using such pixels to determine

a series of features and using such features to assign a probability of a location of a main subject of the digital image in the belief map; and b) cropping the digital image to include main subjects indicated by the belief map to produce the cropped digital image by: i) selecting a crop window having a shape and a zoom factor, said shape and zoom factor determining a size of said crop window; ii) moving the cropped window to a plurality of positions and using the belief map values to select the position which has a high probability of subject content; and iii) cropping the digital image at the high probability subject content position to produce the cropped digital image.

45. A method of cropping a digital image having pixels to produce a cropped digital image, comprising: a) developing a belief map of a photographic image by using such pixels to determine a series of features and using such features to assign a probability of a location of a main subject of the digital image in the belief map; b) using the belief map to determine a center of a mass of the belief map; c) positioning a crop window at a location which includes the center of the mass; and d) cropping the digital image to include main subjects indicated by the belief map to produce the cropped digital image by: i) selecting the crop window to have a shape and a zoom factor, said shape and zoom factor determining a size of said crop window; ii) moving the cropped window to positions and using the belief map values to select the position which has a high probability of subject content; and iii) cropping the digital image at the high probability subject content position to produce the cropped digital image.

46. The method of claim 45 wherein the crop



window is completely within the digital image.

47. A method of cropping a digital image having pixels to produce a cropped digital image, comprising: a) developing a belief map of a photographic image by using such pixels to determine a series of features and using such features to assign a probability of a location of a main subject of the digital image in the belief map; b) performing a clustering of the belief map to identify at least a cluster of highest belief values corresponding to main subject, a cluster of intermediate belief values corresponding to secondary subjects, and a cluster of lowest belief values corresponding to the background; c) using the belief map to determine the center of the mass of the belief map; d) positioning a cropped window at a location which includes the center of mass; and e) cropping the digital image to include at least the main subject found in step b) to produce the cropped digital image by: i) selecting the crop window to have a shape and a zoom factor, said shape and zoom factor determining a size of said crop window; ii) moving the cropped window to a plurality of positions and using the belief map values to select the position which has a high probability of subject content; and iii) cropping the digital image at the high probability subject content position to produce the cropped digital image.

48. The method of claim 47 wherein the crop window is completely within the digital image.